Unusual 5-m *E* region field-aligned irregularities observed from Northern Germany during the magnetic storm of 17 March 2015

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Coherent *E* region echoes were observed during the 17 March 2015 storm at midlatitudes by multistatic wide field of view radars operating in northern Germany. Two of the stations operated in a monostatic configuration, while one link was set in bistatic mode. Interferometry made it feasible to locate the targets. While the radars were built to measure mesospheric winds from specular meteor echoes, the storm was so intense that it allowed them to observe auroral *E* region echoes for more than 4 h. All stations detected numerous examples of narrow spectra with slow (≈180 m/s) and fast (up to 1600 m/s) Doppler velocities. The target speeds were much faster than the Doppler velocities for the slow narrow echoes (more than 800 m/s versus 180 m/s) but comparable to the observed Doppler shift for the 1500 m/s narrow fast types. The narrow types came from localized horizontal structures 50 to 80 km wide in range. The fast narrow types came from the upper part of the altitudes associated with Farley-Buneman waves. The slow narrow structures were typically from altitudes lower than 100 km. Unexpectedly the great majority of the echoes associated with more ordinary ion acoustic turbulence had a positive Doppler shift and came from the east. A companion paper uses these new observations to reevaluate the origin of the narrow echoes and of the asymmetry in the counts. Irrespective of the generation mechanisms, our observations indicate that a combination of unusually large electric field and strong precipitation is needed to produce the unusual echoes.